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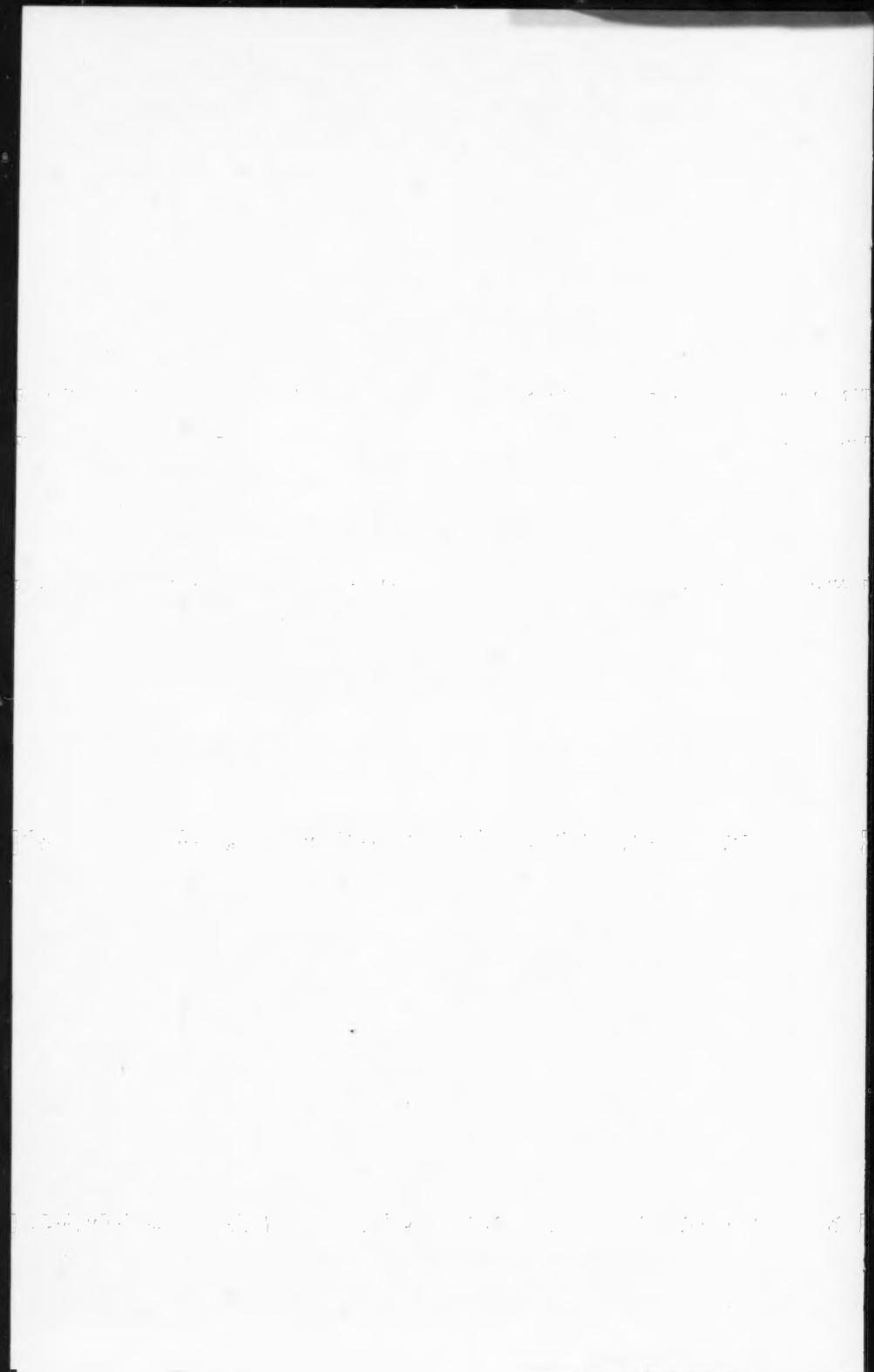
NO. SM 4  
PART 2

*Your attention is invited*

**NEWS  
OF THE  
SOIL  
MECHANICS  
AND  
FOUNDATIONS  
DIVISION  
OF  
ASCE**



JOURNAL OF THE SOIL MECHANICS AND FOUNDATIONS DIVISION  
PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS



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## DIVISION ACTIVITIES

### SOIL MECHANICS AND FOUNDATIONS DIVISION

#### Proceedings of the American Society of Civil Engineers

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#### NEWS

August, 1961

#### COMMITTEE ON PROPERTIES OF SOILS AND SOIL DEPOSITS

The newly formed Division Committee on Properties of Soils and Soil Deposits held its initial meeting on May 5 and 6 in New York City. The membership of this committee includes Professor T. William Lambe, Chairman; Professor James K. Mitchell, Secretary; Mr. David M. Greer; and Mr. Woodland G. Shockley.

The agenda of the meeting included the following items:

1. The arrangement of two half-day technical sessions on soil properties for the Annual Convention to be held in New York in October.
2. A consideration of what the Division and the Committee can do to stimulate interest and research on the part of soil engineers in the areas of soil properties on the moon and other extra-terrestrial bodies. It is believed that the soil engineering profession can and should make significant contributions in the exciting new areas opened up with the advent of the space age.
3. A discussion of the results of a questionnaire recently circulated by M.I.T. dealing with soil properties research and education.
4. The formulation of plans for the future activities of the committee.

The Soil Properties Committee has arranged what it believes to be an outstanding technical program for the October Convention. Papers on timely and challenging subjects have been lined up. Each paper is to be followed by a prepared discussion. Topics to be presented include pore pressures in foundation clays, and swelling of compacted clays, the properties of compacted clay cores taken from in-service earth dams, stress-strain-time effects and strength failure theories. The committee feels confident that the program will be lively and promises ample time for discussion of controversial points. Maximum attendance at these sessions is urged.

As one of its continuing activities the Soil Properties Committee is planning to assemble information on topics in the area of soil properties most in need of research and study. The committee will report on the results of this study and present other news regarding its activities in subsequent issues of the Division Newsletter.

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## TENTH NATIONAL CLAY MINERALS CONFERENCE

The Tenth National Clay Minerals Conference, sponsored by the Clay Minerals Committee of the National Academy of Sciences-National Research Council, will be held on the campus of the University of Texas, Austin, Texas, on October 16-18, 1961. Field trips are planned for Saturday and Sunday, October 14 and 15. All those interested in research or technology in fields related to clays or clay minerals are cordially invited to participate.

Program.—This is the tenth anniversary of the National Clay Minerals Conference, and a program in celebration of this occasion is being planned. Invitations to participate in this anniversary conference have been extended to a number of distinguished contributors from the United States and abroad.

The program is planned around three topics, although original contributions in the general field of clay mineralogy are invited. There will be sections on industrial applications of clay minerals, clay organic complexes, and the origin of bentonitic clays and vermiculite.

Papers presented at the conference may be published in the Proceedings of the Conference (Clays and Clay Minerals), if accepted by the board of editors. The Proceedings will be published by Pergamon Press.

Titles and abstracts of contributions to the general sessions should be submitted to Professor Earl Ingerson, Department of Geology, The University of Texas, Austin 12, Texas, by June 15, 1961. Abstracts should be limited to 250 words and should be informative rather than descriptive. Abstracts should be submitted in duplicate.

Field Trips.—The field trips are planned for the week-end immediately preceding the scientific sessions. One field trip will go to the Texas bentonite deposits in Gonzales County area on Saturday, October 14. Another field trip will visit vermiculite deposits in the Llano area of the central Texas uplift on Sunday, October 15.

Housing.—Excellent motel and hotel accommodations are available near the University in the city of Austin.

Transportation.—Austin, Texas, is served by Braniff, Continental, and Trans-Texas airways with connections at Houston, Dallas, and San Antonio. Austin is also served by the Missouri-Pacific, Southern Pacific, and MKT railroads, and by the Greyhound and Continental Trailways bus lines.

For Further Details Write:

Professor Earl Ingerson, Local Co-chairman  
Tenth National Clay Minerals Conference  
Department of Geology  
The University of Texas  
Austin 12, Texas

NOTICE OF ANNUAL MEETING

Annual Meeting of California Association of Engineering Geologists will be in Sacramento on October 13-15, 1961. Headquarters will be Hotel Senator. Registration in Lobby, October 13. Technical session and banquet on October 13. Business meeting and symposium, subject "The Role of Ground Water in Engineering Geology Problems" on October 14. Field trips to San Luis and New Hogan projects on October 15. Contact Steering Committee, P. O. Box 4164, Sacramento 21, California.

## NEW BOOK PUBLICATION

During September the Geological Society of America will issue REVIEW VOLUMES IN ENGINEERING GEOLOGY, VOLUME I. Thomas Fluhr and R. F. Legget, Editors.

This volume contains eight papers covering fields of petrography applied to portland-cement concrete, photo analysis and interpretation in engineering geology, sand and gravel, engineering seismology, engineering aspects of sediment transport, engineering geology of radioactive waste material, rock bolting, recent U. S. S. R. publications in selected fields of engineering soil science.

Retail Price.—Pre-publication (Until September 1) \$6.00; Post-publication \$7.00.

## LECTURES IN SOIL MECHANICS WELL ATTENDED

The Division of Transportation Engineering of the University of California presented the following special lectures in soil mechanics.

Dr. Gerald A. Leonards, Professor of Civil Engineering, Purdue University.—“The Nature, Significance and Measurement of the Dynamic Properties of Soils”

Dr. T. William Lambe, Professor and Head of Soil Engineering, Massachusetts Institute of Technology.—“Pore Water Pressures - Theoretical Development, Laboratory Measurement and Practical Application”

Dr. Arthur Casagrande, Professor of Soil Mechanics, Howard University.—“Principles of Earth Dam Design” and “Control of Seepage through Foundations and Abutments of Dams” and “Special Features of Important Dam Projects”

These lectures were open to all members of the engineering profession in the area and were extremely well attended. They culminated in an estimate of 200 - 250 for the sessions by Dr. Casagrande.

## SEVENTH ANNUAL CONFERENCE ON MUSKEG RESEARCH

Muskeg research took on an international aspect at the Seventh Canadian Muskeg Research Conference which was held at McMaster University, Hamilton, Ontario, on 18 and 19 April. Research work in this field has been proceeding in Canada for the last ten years and further progress reports were presented to the meeting. For the first time papers on Muskeg research in Japan and in Great Britain were also featured, while amongst the 130 engineers and scientists present were a considerable number from all parts of the United States, American workers being present from both east and west coasts.

McMaster University was host to the Conference, which was the first gathering to use the fine new Men's Residence and new Student Building on this rapidly expanding campus. Dean J. W. Hodgins of the Faculty of Engineering officially welcomed the meeting on behalf of the University and attended the Conference Dinner at which the speaker was Mr. R. F. Legget, who described the start of muskeg research in Canada and raised some questions about future progress that may be anticipated.

The last half-day of the Conference was spent in a visit to the famous Capetown Bog some miles from Hamilton where field demonstrations of sampling techniques, muskeg identification, etc. were carried out for the benefit of those present by Dr. N. W. Radforth and some of his assistants. Dr. Radforth, who is Chairman of the Department of Biology of McMaster University, was the general Chairman of the Conference which was directly sponsored by the Muskeg Sub-committee of the Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada. Dr. Radforth and his assistants presented two of the papers of the Conference describing further progress in their basic research work on Muskeg, which was started at McMaster University more than ten years ago.

Dr. I. Miyakawa, of the Hokkaido Development Bureau, presented a paper to the Conference describing some aspects of research and development of roads over organic terrain in Japan; the paper pointed out the similarity between the terrain parts of Canada and that of Hokkaido, the northern main island of Japan. Mr. J. R. Lake of the Scottish Station of the British Road Research Laboratory, who had come from Scotland especially to attend the Conference, described British investigations on the problem of constructing roads over peat in northern Scotland.

Equally practical approaches to the engineering problems associated with muskeg were reviewed in papers dealing with highway construction in the Great Slave Lake area of Canada's Northwest Territories, in northern Saskatchewan and for forestry operations in northern Ontario. Special interest was attached to a paper by Major J. L. Charles of Winnipeg on the organic terrain factor in northern railway construction in which Major Charles drew upon his many years of experience in railway construction in Canada with Canadian National Railways. He dealt particularly with the Hudson Bay Railway, describing to the meeting the importance of muskeg in such operations.

Rather more unusual aspects of the applications of muskeg research were dealt with in papers covering exploitation of petroleum in the Peace River area of northern Alberta in which access over muskeg is a very real problem; and one by Mr. J. V. Healy in which he described the significant progress being made in Newfoundland by the reclamation of muskeg for agricultural purposes. Since Canada's newest province has so little agricultural soil anywhere, the way in which muskeg is already being used for the production of crops holds important implications for the future of agriculture in that part of Canada. Mr. Ivan C. MacFarlane of the National Research Council presented a review of the corrosive effects upon concrete and metal structures of the water contained in or coming from muskeg, a rather newer problem in this field which is arising because of the steady development of the Canadian North.

In support of these practical approaches to muskeg problems are the field and laboratory research currently in progress into the basic properties of muskeg as a material. In addition to the reports from McMaster University, papers were given on laboratory research work by Mr. J. I. Adams of the Ontario Hydro and Messrs. C. F. Ripley and C. O. Brawner of Vancouver, while the general discussions at the Conference provided further information of interest in this connection.

Since Canada contains at least 500,000 square miles of muskeg, the first general map of which was exhibited to the Conference, from the Defense Research Board, by Dr. Radforth, the practical implications of the basic research work into the properties of muskeg with which these annual Conferences are primarily concerned is naturally very real. This was clearly brought out

by several of the papers given and by the general discussion at the Hamilton Conference. A full record of the meeting will be issued in due course in the form of a technical memorandum of the Associate Committee on Soil and Snow Mechanics. Applications for copies should be addressed to the Secretary of the Committee, c/o the Division of Building Research, National Research Council, Ottawa, Ontario, Canada.

### SYMPORIUM ON LOAD BEARING CAPACITY OF SOILS NEW DELHI, JANUARY 1961

The Central Building Research Institute, Roorkee, in collaboration with the National Buildings Organization, organized a symposium on Load Bearing Capacity of Soils in Delhi on the 23rd and 24th of January, 1961. The symposium was inaugurated by Mr. K. C. Reddy, the Union Minister for Works and Housing. It was attended by about 200 delegates from all over the country representing Central Building Research Institute, Central Road Research Institute, Army Headquarters Engineer-in-Chief's Branch, Central and State Public Works Departments and the Railways. Amongst the foreign participants there were three delegates from Russia, headed by Academecian I. M. Litvinov, Member of the Presidium and Secretary of the Academy of Construction and Architecture of the Ukrainian SSR, Kiev.

Thirty-six papers were presented at the symposium of which eleven were contributed by foreign authors from Japan, Israel, France, Rumania, United Kingdom and United States of America. Besides, two papers from Russia were circulated during the session. The papers were discussed in four different sessions.

Session A dealt with ten papers on "Field Load Bearing Tests and Their Interpretations." Mr. N. G. Dewan, Chief Engineer, Central Public Works Department acted as the Chairman. He stated in his introductory remarks that although so much had been said against the field plate load test, it was still widely followed in the country and any rationalization of this test would be of great value to field engineers.

The general reporter of the session, Mr. A. K. Deb, Senior Scientific Officer, Central Building Research Institute, then presented his report. He mentioned that almost all the authors had advocated the use of field plate load test, though differing as to how best the results could be used for actual evaluation of the Bearing Capacity. Mr. Deb added that although the usual Bearing Capacity equations for frictional soils showed an increase in the bearing capacity value with increase in the footing size, the actual load test results indicated a decrease in bearing capacity with increase in plate sizes. It made him wonder if settlement was to be the guiding principle in the design of footings and if the theoretical finding that bearing capacity should increase with the footing size could be entirely ignored. Mr. Deb also made a specific reference to the straight line relationship between the pressure and settlement-width ratio for sandy soils when plotted to a log-log scale, and added that, if established, it would prove a convenient method of estimating the bearing capacity of sandy soils for all sizes of footings and for any specific settlement.

Twenty-one speakers took part in the discussions and it was generally agreed that there was promise in the logarithmic plotting of load test results and that further work should be done on sandy soils to confirm the findings. Further work was also considered necessary on moisture-bearing capacity relationship, as it was important for Indian climatic conditions.

Session B was concerned with "Laboratory Bearing Capacity Tests and Settlements—Their Estimation, Permissible Allowance, Etc." It also had ten papers and Professor S. R. Mehra, Director, Central Road Research Institute, was the Chairman. Dr. H. L. Uppal, Assistant Director, Central Road Research Institute acted as the General Reporter. He mentioned that three of the papers had stressed the usefulness of field penetration resistance tests in determining the bearing capacity and in two, values based on penetration tests had been compared with those obtained by the Russian method which was based on physical properties of soils. Estimation of settlement by testing undisturbed samples and comparing the values with the actual settlements of structures was the subject of another three papers. In one paper, the case histories of a number of actual foundation failures had been given and the bearing capacity factors as worked out were compared with those given by various workers on theoretical considerations.

Fourteen speakers took part in the discussions and it was brought out that one of the likely reasons why discrepancies were found in the laboratory and field bearing capacity values was that the art of taking undisturbed samples of soil was far from perfect. Further, the actual field conditions were difficult to simulate in the laboratory tests. Further research was considered to be necessary on this aspect of the problem.

Session C was devoted to six papers on "Pile Foundations." Lt. General Sir H. Williams, Director, Central Building Research Institute was in the chair. In his introductory remarks he stressed the need for research to fill up the gap in knowledge which existed in the scientific design of pile foundations. He enumerated the current design practices in the country and pointed out that nearly all of them adopted much too large a factor of safety.

Mr. Sri Krishna, Jt. Director, National Buildings Organization, who was the general reporter, mentioned the salient points of various papers which dealt with the group action of piles by model loading tests, estimation of bearing capacity of bored and driven piles in cohesive soils by a knowledge of the cohesive strength of the soil, effect of lateral thrusts on unreinforced concrete piles, separation of skin friction and point bearing by cyclic loading and comparison of the bearing capacity values obtained from field load tests on piles to those obtained from penetration tests.

Nine speakers took part in the discussions.

A 15 minute movie was also screened by Mr. Dinesh Mohan, showing a typical load test on piles making use of anchor piles and hydraulic jacks.

It was brought out in the discussions that physico-chemical and mineralogical properties of the soils, also being very important, work should be directed in correlating them to the load carrying capacity of the piles. Research was also considered to be necessary on the type of soils in which bored piles were preferable to driven piles and vice versa. Precise knowledge was also found to be lacking on the values of skin friction of the piles in pushing and pulling, both in sands and clays.

Session D dealt with ten papers on "Bearing Capacity Theories;" Actual Design of Foundations and other miscellaneous subjects. Dr. K. L. Rao, Member, Central Water and Power Commission, was in the chair and he stressed the need for some original thinking on the subject. Mr. Dinesh Mohan, Deputy Director, Central Building Research Institute, acted as the general reporter and briefly summarized the papers. The papers covered a wide range of subjects viz. stress distribution in a two layered soil system, soil compaction by vibroflotation, model load tests on footings, foundations on filled up grounds, thixotropy in clays and actual design of footings on two typical sites.

Eleven speakers took part in the discussions and the general opinion was that in model tests further work remained to be done on the scale effect of the model and grain size effect of the soil. The thixotropy in clayey soils was also considered to be an important subject for study, especially for various types of constructions where soil had to be recompacted or vibratory loads such as those due to pile driving and movement of traffic came into play.

Before commencement of the concluding session a demonstration of the field plate load test was arranged by the Central Building Research Institute. The novel feature of the demonstration was the use of a 15 ton loading truss and hold-fasts for anchoring it down to the ground. The holdfasts were half round slotted steel pipes held down with 30-inch steel spikes driven through the slots in place of the usual plate anchors.

#### 1961 ANNUAL CONVENTION IN NEW YORK

A star array of papers and speakers has been promised by the New York Convention Committee for the annual ASCE meeting to be held in New York's Statler-Hilton Hotel, October 16-20. The theme of the convention will be "Metropolis-1980," and many of the papers being sponsored by nearly all of the technical divisions are related to this timely overall theme.

The luncheon speakers also will cover facets of the same theme. They are: Monday, Robert C. Weaver, Administrator of the Housing and Home Finance Agency, who will speak on "Urban Affairs"; Tuesday, Samuel S. Baxter, Water Commissioner and Chief Engineer of the Philadelphia Water Department, whose subject is "Utilities of the Future"; Wednesday, Austin J. Tobin, Executive Director, The Port of New York Authority, speaking on "Mass Transportation of People," and Thursday, Rex Whitton, Federal Highway Administrator, who will discuss "Urban Highways of the Future."

#### TENTATIVE PROGRAM

The following is the tentative program of the Soil Mechanics and Foundations Division sessions at the annual meeting to be held in New York.

##### Thursday October 19, 1961

AM	Presiding: Thomas M. Leps, Chairman, Exec. Committee
9:00 AM	Stabilization of Excavations by Freezing CHARLES P. GAIL, Winston Bros. Co., Morgan City, La.
9:15 AM	Discussion WILLIAM A. O'LEARY, Director, Div. of Sewage Disposal, N.Y.C. Dept. of Public Works
	JAMES D. PARSONS, Assoc. Partner, Moran, Proctor, Mueser & Rutledge, New York; and HENRY A. PFISTERER, Consulting Engr., New Haven, Conn.
9:50 AM	Discussion JOHN LOWE, III, Assoc. Partner, Tippetts-Abbett-McCarthy- Stratton, New York

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10:00 AM Foundation Difficulties and Failures  
JACOB FELD, Consulting Engr., New York

10:30 AM Discussion  
EDWARD E. WHITE, President, Spencer, White & Prentis, New York

PM Presiding: Reginald A. Barron, Vice Chairman, Exec. Committee

2:30 PM Deflection and Stress Measurements on New Sheet Pile Bulkhead at Port of Toledo, Ohio  
PETER A. HAKMAN, Assoc. and Head, Structural Dept., and WARREN M. BUSER, Structural Engr., Parsons, Brinckerhoff, Quade & Douglas, New York

3:00 PM Measurements on the New Pier at 39th Street, Gowanus Bay, Brooklyn, N. Y.  
LEWIS H. RABBAGE, USNR CEC Ret., Chief Engr., Dept. of Marine and Aviation, New York

3:30 PM Measurements of the New Pier 11 at the Brooklyn Port Authority  
JOHN M. KYLE, Chief Engr., MARTIN S. KAPP, Soils Engr., DONALD YORK, Asst. Soils Engr., and STEPHEN CIMBOLIC, Engr. 111, Port of New York Authority, New York

4:00 PM Discussion  
STANLEY D. WILSON, Partner, Shannon & Wilson, Seattle, Wash.

4:15 PM Discussion  
GREGORY P. TSCHEBOTARIOFF, Prof. Dept. of Civil Eng., Princeton Univ., Princeton, N. J.

Friday October 20, 1961

AM Presiding: Jorj O. Osterberg, Member, Exec. Committee

9:00 AM Experiences with Canadian Varved Clays  
VICTOR MILLIGAN, Principal, H. Q. Golder Assoc., Ltd., and L. G. SODERMAN, formerly Principal Foundation Engr., Dept. of Highways, Ontario

9:25 AM Pore Pressures in a Foundation Clay  
T. WILLIAM LAMBE, Prof. and Head of Soil Engineering, Mass. Inst. of Technology, Cambridge

9:50 AM Prediction of Swelling Potential for Compacted Clays  
H. BOLTON SEED, Prof. of Soil Mechanics, Univ. of Calif., and R. J. WOODWARD, Sr. Partner, and R. LUNDGREN, Partner, Woodward, Clyde, Sherard and Assocs., Oakland, Calif.

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10:15 AM	Strength Tests on Undisturbed and Remolded-Recompacted Samples from Two Twenty-Year-Old Earth Dams
	RONALD C. HIRSCHFELD, Asst. Prof. of Soil Mechanics, Harvard Univ., Cambridge, Mass.
PM	Presiding: H. Bolton Seed, Secretary, Exec. Committee
2:30 PM	Review of Paris Conference Papers on Soil Properties
	G. A. LEONARDS, Prof. of Soil Mechanics, Purdue Univ., Lafayette, Ind.
2:55 PM	Shearing Resistance of Sands During Rapid Loadings
	ROBERT V. WHITMAN, Assoc. Prof. of Soil Eng., and KENT A. HEALY, Research Asst., Mass. Inst. of Technology, Cambridge
3:20 PM	The Effect of Material Properties on Consolidation and Secondary Compression
	ROBERT L. SCHIFFMAN, Assoc. Prof. of Soil Mechanics, the Winslow Labs., Rensselaer Polytechnic Inst., Troy, N. Y.
3:45 PM	New Concepts of Shearing Strength for Clay Soils
	W. E. SCHMID, Assoc. Prof. of Civil Eng., Princeton Univ., Princeton, N. J.

#### NEW ASCE TRANSACTIONS SOON TO GO TO PRESS

In mid-May all Society members received a brochure describing the revamping that the TRANSACTIONS are undergoing. Since that time thousands of orders have been received, but still more should have reached us.

Beginning with Volume 126 (1961), TRANSACTIONS will be issued as a standard set of five parts, containing all Division Journal papers, according to the following schedule:

Part I	Engineering Mechanics, Hydraulics, Soil Mechanics and Foundations
Part II	Construction, Structural
Part III	Irrigation and Drainage, Power, Sanitary Engineering
Part IV	Air Transport, City Planning, Highway, Pipeline, Surveying and Mapping, Waterways and Harbors
Part V	Professional Practice

Members of ASCE can enter standing orders to any one, or more, of Parts I through IV at \$3.50 each per year; the price for Part V will be \$2.00 per year. Members can effect a considerable saving by subscribing to all five parts—the total price of \$16.00 is reduced to \$10.00.

Part V is reserved for the papers published in the Journal of Professional Practice, which is of interest to all members, regardless of their technical specialties. Part V will also contain the President's Annual Address, abstracts of the memoirs of deceased members, Final Reports of Committees in the Department of Conditions of Practice, and combined subject and author indexes for Parts I through V.

A single binding has been selected, more attractive and durable than the paper, cloth, and morocco-grained covers used in the past. This binding will be in the Society's official Royal Blue, composed of cloth impregnated with vinyl. The spine will contain horizontal rules to match those used previously on the morocco-grained volumes. The binding and gold stamping will resist fading and will not deteriorate in warm, moist climates.

The TRANSACTIONS will be mailed in December of each year and the bills will be sent out at that time.

Please use the coupon below to place your order. Do not send in a coupon if you previously mailed the original order card.

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#### TO ASCE MEMBERS OF CHI EPSILON

Chi Epsilon Fraternity, national civil engineering honor society, has officially offered to supply the funds necessary to furnish a formal Conference Room at the United Engineering Center. This room will be on the ASCE executive floor, will be named "The Chi Epsilon Room", and will be available for conference and committee meetings.

Pledges are not expected, but single voluntary gifts, from members and friends of the Fraternity are earnestly solicited. An attractive Commemoration Book has been planned in which donors of \$100 or more (singly or in groups) may inscribe the name of a revered person.

On request, the national chairman, Samuel Kramer (8701 Shore Road, Brooklyn 9, New York) will be glad to mail a descriptive brochure. Your gift

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is tax deductible if you make your check out to "ASCE CHI EPSILON ROOM FUND" and mail it to Mr. Donald D. King, ASCE, 33 West 39th Street, New York 18, N. Y. Your gift will be automatically credited to the quota of your initiating Chapter. The national goal is \$10,000.

#### RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

The papers presented at the ASCE Research Conference on Shear Strength of Cohesive Soils held at the University of Colorado, in June 1960, have been published in a single hardbound volume. The book contains the Foreword, Conference Program, Photographic Report, Opening Address, and all 26 Conference Papers. Also included are the written discussions and closures, and the reports by the moderators of panel sessions. The book has been prepared in an attractive cloth binding and is complete with a Table of Contents - Subject Index and Index of Authors and Discussers.

The list price for this volume is \$10.00 per copy (net); no discounts are available.

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Please send \_\_\_\_\_ copy(s) of the Research Conference on Shear Strength of Cohesive Soils.

The amount enclosed is \$ \_\_\_\_\_.

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#### OCTOBER NEWSLETTER

Deadline date for arrival at this office of contributions for the October Newsletter: August 25, please.

Bernard B. Gordon  
State of California Department of Water Resources  
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Sacramento 2, California

Wilbur M. Haas, Assistant Editor  
Michigan College of Mining and Technology  
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August, 1961

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